MEASURES OF DISEASE FREQUENCY

Part 2

24-10-2022

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Country, Other	Total Cases	New Cases	Total Deaths	New Deaths	Total Recovered	Active Cases	Serious, Critical	Tot Cases/ 1M pop	Deaths/ 1M pop	Total Tests	Tests/ 1M pop	Population
Morocco	327,528		5,396		275,158	46,974	1,007	8,832	146	3,814,442	102,861	37,083,615
Switzerland	304,593	+4,241	4,277	+55	211,500	88,816	524	35,092	493	2,592,950	298,735	8,679,774
Portugal	268,721	+3,919	4,056	+85	184,233	80,432	506	26,385	398	4,318,338	423,999	10,184,777
Austria	254,710	+4,377	2,577	+118	182,620	69,513	704	28,217	285	2,929,927	324,579	9,026,852
Sweden	225,560		6,500	+15	N/A	N/A	192	22,279	642	2,914,088	287,831	10,124,317
Nepal	224,078	+1,790	1,361	+24	204,858	17,859		7,637	46	1,681,299	57,299	29,342,758
Jordan	192,996	+4,586	2,380	+78	125,433	65,183	460	18,841	232	2,408,242	235,105	10,243,280
Ecuador	185,944		13,225		164,009	8,710	365	10,477	745	622,833	35,092	17,748,657
Hungary	181,881	+3,929	4,008	+117	44,020	133,853	638	18,847	415	1,528,302	158,365	9,650,510
UAE	161,365	+1,310	559	+5	150,261	10,545		16,238	56	15,960,104	1,606,023	9,937,659
Panama	155,658		2,973		137,004	15,681	146	35,853	685	838,981	193,246	4,341,525
Bolivia	144,034	+56	8,916	+9	119,548	15,570	71	12,273	760	353,955	30,160	11,735,888
Kuwait	140,795	+402	870	+2	133,407	6,518	75	32,778	203	1,062,076	247,254	4,295,477
Dominican Republic	139,111	+282	2,313	+2	113,134	23,664	172	12,773	212	687,292	63,106	10,891,021

Population at risk

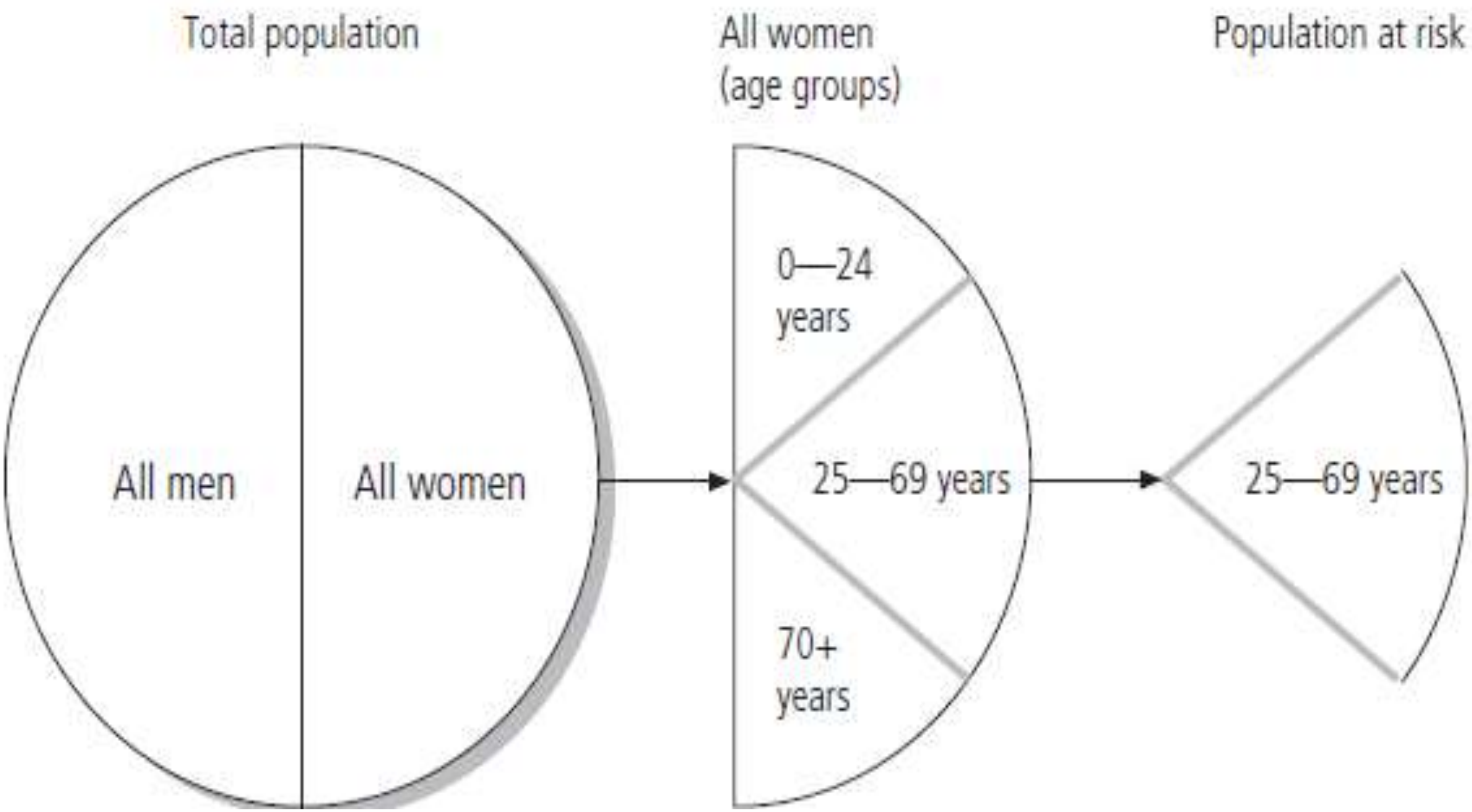
The people who are susceptible to a given disease are called the population at risk, and can be defined by demographic, geographic or environmental factors.

- **An important factor in calculating measures** of disease frequency is **the correct estimate of the numbers of people under study.**
- **Ideally these numbers should only include people who are potentially susceptible to the diseases being studied.**
- **For instance, men should not be included when calculating the frequency of cervical cancer**

The population at risk is the group of people susceptible to develop a characteristic. **For example when studying measles, the population at risk used for the calculation should be the children under five years of age, because measles is rare after that age.** **The population at risk is used as the denominator when calculating proportions or rates**

Population at risk

Figure 2.1. Population at risk in a study of carcinoma of the cervix



2 Attack rate:

- **A specific form of incidence rate in which there is a limited period of risk as in:**
- **cases of epidemics reflecting the virulence of the organisms.**

3 Secondary attack rate = № of secondary cases x100 / № of susceptible

$$\text{Secondary attack rate} = \frac{\text{№ of secondary cases}}{\text{№ of susceptible}} \times 100$$

- This rate is used to **measure the ease of communicability** in case of communicable diseases
- The **length of incubation period** is important to identify the secondary cases.
- **Immune Individuals (whether due to natural infection or immunization) should be excluded from the denominator**

Incidence

There are three main ways incidence is reported:

1. **Incidence rate**

2. **Cumulative Incidence or attack rate**

3. **Incidence density**

morbidity
- Incidence
- Prevalence
- Attack Rate

Prevalence

Prevalence

is the № of All cases of disease,, or condition, present at a particular time , in relation to the size of population from which it is drown.

Prevalence means ALL. (Old+ New)

Prevalence

quantifies the proportion of individuals in a population who have the disease at a specific time

Prevalence: in the number of cases of a disease present in a defined population at a given point of time

*Proportion of a population already affected by a particular disease at a particular time

A study done on 1500 school children at Al-Karak , during 2020 found 20 with TB. By follow up during 2021 the number of students with TB 28

- Incidence new cases only 2021 = 8

prevalence ?? 2020

prevalence ?? 2021

- Prevalence 2020 = 20/1500x1000=13.33/1000population/year
- Prevalence 2021 =28/1500X1000=18.66/1000population/year

Thus, prevalence can be thought of as the status of the disease in a population at a point in time and as such is also referred to as point prevalence example,

visual examination survey conducted in Al Karak among individuals , 52 - 85 years of age, during 2021

310 of the 2477 persons examined had cataracts at the time of the survey. ???????

The prevalence of cataract in that age group was

P = № of existing cases of a disease X 100
total population at risk at a given point in time

310 / 2477 X100 ,=12.5% prevalence of cataract among population aging 52 - 85 years in Al Karak during 2021

Prevalence is controlled by two elements

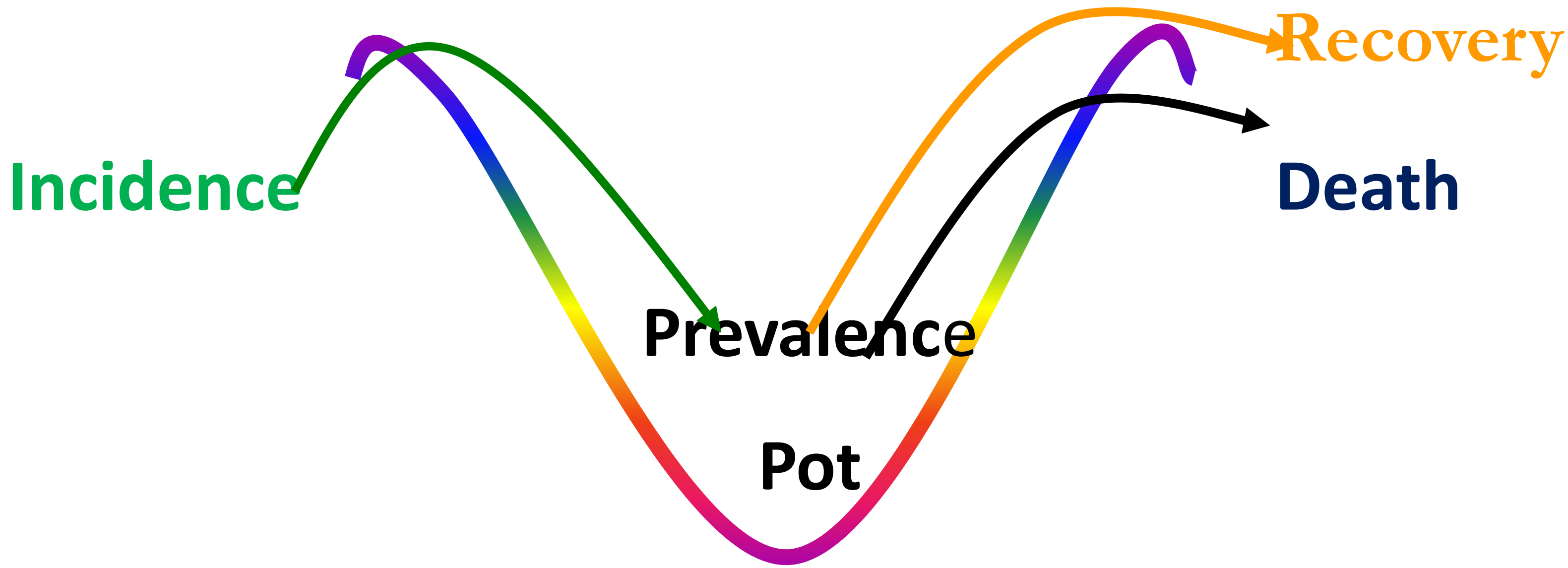
- No. of individuals who have been diseased in the past
- the length or duration of the illness.

Prevalence will vary in direct relation — Duration and Incidence

↑ duration of the illness → ↑ Prevalence

↑ incidence → ↑ Prevalence

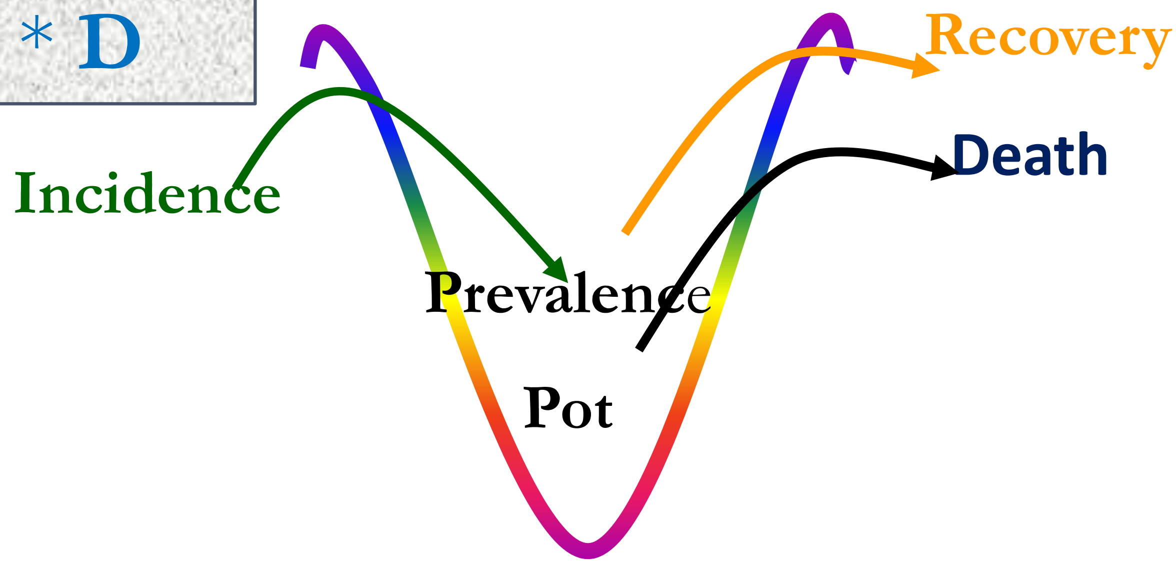
Relationship Between Incidence and Prevalence



Incidence is **all new** cases of the disease.
They enter the prevalence pot.
If no cases leave the prevalence pot, it continues to Fill, adding to the number of cases **unless** some cases either **recover** or **die** **reducing the prevalence**.

Relationship Between Incidence and Prevalence

Prevalence = I * D



I = incidence

D = duration

Prevalence will vary in direct relation → **Duration and Incidence**

Prevalence

Increased by:

- longer duration of disease
- prolongation of life without cure
- Increase in the incidence of the disease
- Immigration of cases
- out migration of healthy people
- improved diagnosis
- Better reporting

Decreased by:

-short duration of disease

-high case-fatality rate from disease

decrease incidence

in-migration of healthy people

-Emigration of cases

-improved cure rate

-Immunization prevents new cases

-Prolongation of non diseased & healthy population

Types of Prevalence

1. Period Prevalence
2. Point Prevalence

A study done on 1500 school children at Al Karak during 2020 found 20 with TB. By follow up of school children during 2021 the number of students with TB was 28

prevalence 20 2020

prevalence 28 2021

Period prevalence:

Number of cases that occur **during a specified period of time**

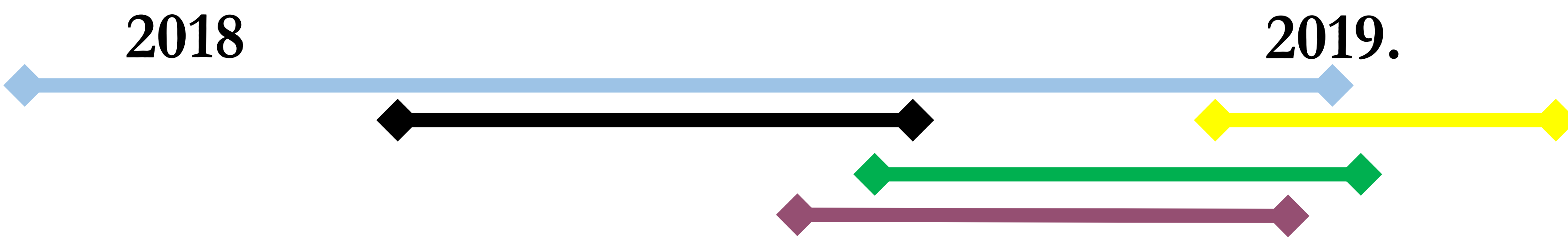
2020 –2021

Period Prevalence

includes the total individuals who had have the dis. of concern at any time during the specific time period 2018-2019. S0

Period .P

started at a point of time and stop at a point of time included all persons with the dis.



- that have carried over from the previous time period or
- have become ill at the end of the time period
- New cases (incidence) occurring within the time period
- recurrences during a succeeding time period

Point Prevalence

is the No. of cases of individuals with a disease, condition, or illness at a single specific point in time
The No. of existing cases at point in time.

$$P = \frac{\text{№ of existing cases of a disease}}{\text{total population at risk at a given point in time}} \times 100$$

Point .P

measure the presence of the disease or condition on a single short – time point

example

visual examination survey conducted among individuals 52 - 85 years of age in Al-Karak during 2021. **310** of the 2477 persons examined had cataracts at the time of the survey.

The prevalence of cataract in that age group was

310 / 2477 X100 ,=12.5%
prevalence of cataract among population aging 52 - 85 years in Al Karak during 2021

Point prevalence:

Number of cases present at a specified moment of time 2021

Period Prevalence =

$$\frac{\text{No. of existing cases of a disease within time period}}{\text{Average study population within time period}} \times 1000$$

Point Prevalence =

$$\frac{\text{No. of existing cases of the disease at a point in time}}{\text{Total study population at a point in time}} \times 1000$$

Factors affecting the prevalence and incident rate:

1. In and out migration of susceptible or of the resistant (immune)
2. Changes in the environmental quality (air and water sanitation)
3. Changes in the social customs (tobacco smoke) and travel abroad.
4. Changes in the reporting system.
5. Changes in the preventing program (immunization)

Mortality rates

- Analogous to incidence but refers to the process of dying rather than the process of becoming ill.

Crude death rate: =

$$\frac{\text{№ of deaths in certain population in a year \& locality}}{\text{№ of population in the same year and locality}}$$

- The crude death rate is
- calculated for the total population irrespective of age, sex, or any other characteristics of importance in determining death
- If the population is growing or shrinking, use the population size at the midpoint of the time interval as
- an estimate of the average population at risk.
- E.g. death rate for 1993, use population of July 1st 1993 for the denominator.

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2. Age and sex specific death rate:

A. Age Specific Death Rate:

No. of persons dying in a certain age and a certain year and area X1000

Total № of the same age group in the same year and same area

Example of age specific mortality rates::

- Infant mortality rate=

Total № of deaths aged from zero to lessthan one year during a year and a given locality X100

Total № of live births in the same Year and locality

B. Sex Specific Death Rate:

№ of deaths in a certain sex during a year in a certain locality X1000

Total № of the same sex during the same year &locality

3. Cause Specific Mortality Rate=

$$\frac{\text{Total № of deaths due to a certain cause during a year and a given locality}}{\text{Estimated midyear population during the same year \& locality}} \times 100$$

4. Case Fatality Rate=

$$\frac{\text{Total №. of deaths from certain disease in specific time \& place}}{\text{Total № of those having the same disease in the same time \&place}} \times 1000$$

5. Proportionate Mortality Rates=

$$\frac{\text{Total № of deaths due to a certain cause during a year in given locality}}{\text{Total № of deaths from all causes during the same year \& locality}} \times 1000$$

Uses of Morbidity and Mortality Rates

1) Case fatality rate is used for measuring the pathogenesis and virulence of agent of the disease.
2) Secondary attack rate is used to measure the ease of communicability of communicable diseases.
3) Morbidity and mortality rates can be used to allow comparison of disease frequencies and deaths in different population and all over years

Uses of Morbidity and Mortality Rates

4) Comparison of two rates result in a ratio (relative risk or risk ratio) e.g.:

- If the incidence rate of diarrheal disease among bottle fed (a)is 20 % while among breast fed (b)is 2 %,
- then the relative risk or risk ratio = 20/2= 10,
- i. e. the bottle fed children have a 10 times greater risk of developing diarrheal disease than the breast fed.

interpretation

Relative risk = incidence a / incidence b

If both are equal then it is 1 → (no risk)

If a > b then it is more than one, → it is risky

If a < b then it is less than one, → protective

5. Difference between two incidence rates is called

attributable risk=

$$\frac{\text{Incidence of disease rate among exposed} - \text{incidence of disease rate among non-exposed}}{\text{Incidence rate of disease among exposed}} \times 100$$

In the previous example: Attributable risk = $\frac{20-2}{20} \times 100$

= 90%child/year (this is the risk diarrhea attributing to bottle feeding.

interpretation

Attributable risk = $\frac{\text{incidence } a - \text{incidence } b}{\text{incidence } a}$

If both are equal then it is 0 (no risk)

If a > b then it is more than zero, it is risky

If a < b then it is less than zero, protective example

In a study in the United States of America, the incidence rate of stroke was measured in a population of women who were 30–55 years of age and free from coronary heart disease, stroke and cancer in 1976. A total of 274 stroke cases were identified in eight years of follow-up .

Never smoked : 70 cases among 395 594

Ex-smoker : 65 cases among 232 712

Smoker: 139 cases among 280 141

Calculate

-Incidence for each group

-Relative for smoking

-attributable risk for smoking (ignore ex-smoker

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Smoking category	Number of cases of stroke	Person-years of observation (over 8 years)
Never smoked	70	395 594
Ex-smoker	65	232 712
Smoker	139	280 141
Total	274	908 447

Table 2.4. Relationship between cigarette smoking and incidence rate of stroke in a cohort of 118 539 women[12]

Smoking category	Number of cases of stroke	Person-years of observation (over 8 years)	Stroke incidence rate (per 100 000) person-years)
Never smoked	70	395 594	17.7
Ex-smoker	65	232 712	27.9
Smoker	139	280 141	49.6
Total	274	908 447	30.2

Relative risk = 49.6/ 17.7 = 2.80

Attributable risk= $\frac{49.6 - 17.7}{49.6}$ **X100= 46.31 %**

Attributable risk can be useful as a measure of the public health impact of a particular exposure

Risk difference (attributable risk)

the risk difference tells you the amount of disease that potentially could be prevented if the risk factor could be eliminated

Attributable risk can be useful as a measure of the public health impact of a particular exposure

Population Attributable Risk (PARs)

PAR **tells us about the amount of extra disease occurring in the exposed group because of exposure.**

How **much of disease in the whole community** can be attributed to the exposure

$$PAR = I_T - I_0$$

I_T is the rate in the population

I_0 is the rate in the unexposed group

Population Attributable Risk

PAR estimate the excess rate of disease in the total study population of exposed and non-exposed **individuals that is attributable to the exposure.**

PAR, helps determine which exposures have the most relevance to the health of a community

$$PAR = I_T - I_0$$

I_T is the rate in the population
I_0 is the rate in the unexposed group

Population AR Versus AR

AR tell us how much disease in exposed group can be attributed to exposure

PAR: how much disease in the whole population can be attributed to exposure

The population attributable-risk percent (PAR%)

PAR% expresses the **proportion of disease in the study population that is attributable to** the exposure **and thus could be eliminated (removed) if the exposure were eliminated**

$$PAR\% = \frac{PAR}{I_T} \times 100$$

RISK ESTIMATES(Odds ratio)

□Odds ratio (OR)

Results of a study can be presented in a **2x2 table** as follow

	Case (diseases)	control	Total
Exposed	a	b	a+b
Unexposed	c	d	c+d
Total	a+c	b+d	N

OR= a/(a+c) ÷ b/(b+d)= a/c ÷ b/d =ad/bc

c/(a+c) d/(b+d)

which is the ratio of the odds of exposure among the cases to the odds of exposure among the controls.

Example:

A study was conducted to test the association between smoking and cancer of the pancreas. Of the 100 cancer pancreas cases 60 of them were smokers , while of the 400 have no cancer pancreas, 100 were smokers. Calculation of the OR from

Table 1. smoking and ca pancreas

Exposure	Ca pancr	no Ca pancr	Total
Smokers	**60 (a)**	**100 (b)**	**160**
Non Smokers	**40 (c)**	**300 (d)**	**340**
Total	**100**	**400**	**500**

$$\mathbf{OR} = \frac{60 \times 300}{100 \times 40}$$

$$\mathbf{OR} = 4.5$$

$$OR = \frac{a/c}{b/d} = \frac{ad}{bc}$$

THANK YOU ALL

Example

Data from a cohort study of oral contraceptive (OC) use and bacteriuria among women aged 16-49 years

	Bacteriuria		
	Yes	No	Total
OC use			
Yes	27	455	482
No	77	1831	1908
Total	104	2286	2390

Data from D. A. Evans et al., Oral contraceptives and bacteriuria in a community-based study. *N. Engl. J. Med.* 299:536, 1978.

The population attributable risk of bacteriuria associated with OC use can therefore be calculated as:

PAR=I_T - I_0= 104/2390 - 77/1908 == 316/10^5/year

Thus, if OC use were stopped, the-excess annual incidence rate of bacteriuria that could be eliminated among women in this study is 316 per 100,000.

$$\text{Relative Risk } (RR) = \frac{27/482}{77/1908} = 1.4$$

example

The following table shows the data concerning a NCD among adults during a year in a certain community. Calculate the prevalence and incidence rates,
If male sex was the risk factor what is the relative and attributable risks for this factor.

	New case	Old case	Total population
females	4	12	6213
males	9	24	5365
Both sexes	13	36	11578

Incidence among males
Incidence among females
Total incidence
Relative risk
Attributable risk

Prevalence among males
Prevalence among females
Total prevalence

(for prevalence old + new case)